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Implications for Development of the Collective Training Information System (CTIS)

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In order to make a preliminary determination of components of a Collective Training Information System, the Army Training Board requested that the Army Research Institute conduct an Information Needs Assessment. A series of semi-structured interviews were conducted with training managers, executives, and ARTEP developers.

Interviews revealed a definite need for feedback from field users of ARTEP documents to the developers pertaining to the quality and utility of their → over

20. Abstract (cont.)

products. Needed evaluation feedback by field units at various levels revealed a number of issues that a collection information system would need to take into account. This report presents a summary of these issues and outlines information system requirements and methods that could address the identified issues.

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INTRODUCTION

The purpose of this report is to summarize and extend the Collective Training Information System (CTIS) work conducted for ATB over the past year. The primary focus is on developing preliminary concepts for the CTIS, partly based on information needs and operational considerations of three potential user groups surveyed by ARI. It should be emphasized that in many cases this report goes well beyond the data collected during the needs assessment survey. This approach was taken in order to provide meaningful discussions of the implications of the survey results in a systems development context. Also, some systems development issues which did not emerge from the survey are covered here insofar as they seemed useful in defining CTIS requirements. Wherever it seemed advisable, potential solutions to development problems have been proposed, and some topics in need of further examination have been identified. In contrast to the survey reports, then, this document is relatively narrow in scope, concentrates on CTIS issues, and does not cover many of the job and ARTEP-related topics included in the survey.

This summary report is intentionally brief and covers the more salient development issues at a conceptual level. Detailed discussions of technical issues have not been included, and indeed are not appropriate, until consensus on system concepts has been reached. This report, then, should be viewed as a preliminary step toward establishing requirements and priorities for the CTIS development process.

Before proceeding to the main topic, let us briefly outline the needs assessment effort. The assessment consisted of interviews with members of each of three potential CTIS user groups: collective training developers, unit training managers, and unit executives. Training developers consisted of service school managers and action officers involved in developing ARTEP materials. Training managers were battalion and company commanders. Executives consisted of brigade commanders, G-3s, and one Commanding General. Interviews were semi-structured and covered a variety of topics including opinions of the Army Training and Evalation Program, perceptions of potential users' jobs, reporting requirements, and needs for training-related information. Of special interest here are the examples of training data computer printouts which were given to each respondent for evaluation. These consisted of several ARTEP-derived examples each in a somewhat different format, level of aggregation, or categorization scheme. The principal ones showed percentages of ARTEP standards achieved aggregated into task/subtask, functional area (e.g., planning), or weapon system categories. Examples were presented data by platoon, by battalion or by platoon over time (trends). Respondents were also asked to comment on the usefulness of normative data presentations. For example, data from a given unit might be presented with division or even Army-wide averages for comparison purposes. Detailed comments by respondents are covered in the three previous reports and will not be presented here. Finally, the caveats regarding the small sample size and the representativeness of the sample, which were made in the three previous needs assessment reports, are, of course, equally applicable to the inferences made in this report.

GENERAL INFORMATION REQUIREMENTS

There appeared to be substantial support for the CTIS concept, but the support was tempered by reservations. These reservations centered on the respondents' prior experiences with innovations which have generated increased burdens without yielding comparable benefits. Such concerns tended to be pervasive, and if not effectively countered, they could develop into a significant implementation barrier. In order to maximize the potential for success, early developments should concentrate on those aspects which help primary users on their daily jobs and which require the least amount of change or support within the user organizations. Moreover, a close working relationship between the user and the developers is mandatory, especially in the early stages of development. A very good guideline for developing and implementing innovations along these lines is contained in "A Guide to Implementation of Training Products," by Gray and Roberts-Gray. The respondents' concerns notwithstanding, most saw the CTIS as having significant potential for increasing the amounts and types of information available to them, and for improving the efficiency of operations.

Not surprisingly, reported information needs differed considerably between the three user groups. However, the differences between operational unit users (i.e., training managers and unit executives) differed primarily in level of detail and data presentation formats. Training developers, on the other hand, reported wanting different types of information than user units.

a. Training Developers

Respondents indicated a need for information on the users perceptions of the quality of the training products which are sent to the field. Without such information, they contended, improvements to existing training products or development of high quality new products is exceedingly difficult. Respondents' comments indicate that highly detailed information is required. For example, if unit personnel indicate that some training objectives are unclear, training developers will need to know which specific tasks, conditions or standards are problems, and the users' assessments of the sources of the problem in each case. In order to handle this kind of textual information CTIS developers should incorporate the capability for the input and analysis of free-format information and should consider developing a scheme for using codes to flag and categorize common types of problems.

There is, at present, no routine mechanism for obtaining information from field user groups, and transmitting that information to the appropriate developers. It is apparent that such a mechanism is a key aspect of the projected CTIS, and the information problem must be solved if the system is to yield substantial long-term benefits to the training development community.

Although training developers indicated no need for performance data per se, some of those data could help to identify problems with fielded training objectives. For example, the frequency of "not evaluated," or similar entries could give developers information about ARTEP standards which are difficult to

apply in the field. Data on the frequencies of tasks and subtasks evaluated during ARTEP exercises could provide important information on actual unit training priorities and enable developers to focus their efforts better. Also, these kinds of information should be easier to obtain than unit performance data, as they are generally not considered sensitive, and impose no additional data collection burden on the unit.

b. Training Managers.

Respondents reported that they need information which would help them determine the strengths and weaknesses of their units, and of the leaders of their units. Although ARTEP task-based displays of training data were regarded favorably, respondents' comments suggest that the CTIS should incorporate software for displaying separately those data bearing on leader performance from those data dealing with performance of the unit as a whole. Moreover, a relatively fine level of detail is required to develop and manage effective unit training programs. Broad summaries are generally not very useful at the battalion level except for reporting to higher echelons. Comments suggest that a CTIS software which assisted managers in identifying commonalties of and reasons for training deficiencies would be favorably received. In general, training managers did not find displays of training data in terms of weapon-systems or trends to be very useful. One of the reasons that trends were not viewed more favorably was the impact of turbulence and turnover on training activities. Were the personnel problems to become less severe, some trend data could be useful in evaluating the success of unit training programs and possibly the soundness of unit training management practices. Thus, CTIS developers should plan to develop software to support trend analyses in the future.

Although respondents did not indicate a need for training data organized into function categories, several noted that some data organization fully consistent with National Training Center take-home package or after action report organization was highly desirable. The NTC data information is organized into "seven operating systems" which are similar in many respects to the functional area categories, but there are currently several inconsistencies between the two categorization schemes. These differences will need to be addressed by CTIS developers and the NTC-TRADOC personnel in order to develop a common organizational scheme. An important area for work in the near-term is development of a systematic method for translating NTC data into concrete training guidance at the lower echelons (i.e., company and platoon levels). Currently there are no explicit associations between ARTEP tasks, conditions and standards and the NTC "operating systems." A "crosswalk" between these two types of training frameworks could enhance the usefulness and acceptance of the CTIS at the unit level.

Respondents consistently complained that extensive management related paperwork adversely affects the time they are able to devote to training activities. This finding suggests that the CTIS developers should examine the requirements for and feasibility of establishing an interface between the CTIS and an automated aid to training management.

c. Unit Executives.

Executive respondents reported desiring the same general types of information as the training managers. However, because of the broader nature of their responsibilities, less detailed information is needed. For example, the executives found performance information organized into functional and subfunctional area categories potentially useful but did not consistently indicate needs for task/sub-task, or weapon-system aggregated data. Like the training managers, these respondents also noted that some data organization consistent with National Training Center will be needed. Although executive respondents generally preferred broad summaries of training data, some indicated that they would prefer to have the capability for reviewing detailed information. This finding suggests that the unit executive component of the CTIS be structured hierarchically with the broader summaries as the display "default option" and more detailed data available upon specific query. That is, when an executive user requests information, the highest level aggregation would be displayed first and progressively finer levels of detail would be available upon subsequent requests.

Respondents did not indicate a great need for trend data, basically for the same reasons given by training managers, i.e., the effects of personnel turbulence and turnover. Some did, however, suggest that normative data could be helpful in determining how realistic their expectations regarding the effects of training are.

d. Additional Considerations

At the primary user level, trainers and training managers are usually aware of their units' idiosyncracies. But, outside the unit, performance data often becomes difficult to interpret. CTIS developers should consider incorporating information into the data base which would help external users to accurately interpret and employ unit training information. Data on unit characteristics (e.g., turbulence and turnover rates, percentage fill, and training history), evaluator experience, exercise conditions, etc. could aid CTIS training development and unit executive user groups. In addition, information on individual skill requirements for ARTEP training objectives, doctrinal literature bearing on tactical tasks, alternative training methods for remedial training, etc. could provide valuable assistance to training development users. Compilation of such lists is not particularly complicated, but constructing a detailed cross-reference indexing system is a painstaking, time consuming process. Fortunately, some of the groundwork has been laid in the course of developing the Company Training Plan with its fairly extensive cross-references. CTIS developers should be able to apply much of this work directly in developing the CTIS data base file structure. Provisions will need to be made for parallel efforts by each of the Service Schools. Depending on the timing of a prototype CTIS implementation effort in these institutions, software could be developed to support construction of cross-reference indexes.

QUALITY CONTROL

Although the training development respondents did not raise quality control issues with regard to their own operations, the CTIS could help to control the quality of ARTEP products. The CTIS software to support both the Collective Front-end Analysis (CFEA) management and the CFEA itself could incorporate the capability to create audit trails for each collective task, thereby helping to insure that critical development steps are not omitted. Also, criteria which training objectives should meet and common deficiency cues could be incorporated in the CTIS software to help developers improve the consistency and the quality of their products.

Many respondents expressed concern over quality control issues, and were especially skeptical about the quality of performance data resulting from tactical field exercises. Among the reasons cited were lack of experienced evaluators, limited amounts of time for evaluator training and variations in exercise conditions (weather, force ratios, terrain, etc.). Although such issues are mostly outside the scope of the CTIS development per se, if not ameliorated they are likely to undermine the credibility of the system and adversely affect the extent of utilization. In cases in which data is somewhat suspect, one partial solution is to document probable sources of anomalies, thus providing interpretive aids to the users. For example, if lack of evaluator experience is a probable contributor to poor data quality, information on evaluator ranks, MOS, time-in-grade, number of exercises previously evaluated and so on, can help the user to interpret the data accurately. As noted earlier, other interpretative aids might include data on the units recent training history, turbulence and turnover, percentage fill, exercise conditions and training devices employed. Because the performance data is not expected to be of exceptionally high quality, CTIS developers should anticipate incorporation of as much capability for cross-checking data as possible.

Other ARI-POM efforts should also have a positive influence on some primary quality control problems. For example, improved guidance on evaluator training and evalution methods is being prepared to help units conduct better ARTEP evaluations, and work in support of the USAIS is expected to result in more objective, easily applied evaluation standards.

INFORMATION ANALYSIS AND USE

The data analysis requirements identified by respondents are mostly straightforward sums, percentages and averages. Complicated analytic support software is not required. However, as mentioned above, training developers will probably require extensive cross-referencing capabilities, as well as capability for manipulating other non-numerical information. There are currently available a variety of relational data base management systems (DBMS) that could be used to satisfy such requirements. Which of these is selected will depend mainly on the hardware and operating system on which the CTIS is to be implemented, the flexibility required, and cost considerations. In addition to the DBMS, training developers may need other kinds of software to support their efforts, little of

which will probably be commercially available. For example, managers of training development activities may need management support software to help them keep track of product developments, exercise some quality control functions, produce periodic reports, estimate work requirements, and so on. Training developers may need software to support improved CFEAs, up-date task files, identify development problems and to facilitate production. Extensive coordination and interviews with the Service School collective training developers will be needed to determine firm requirements.

In the longer term the CTIS may be used to support senior Army executives, combat and doctrine developers, the combat modeling community and others. Some of these users are likely to require very succinct summaries of complex data sets. Meeting such needs is likely to require development of extensive and rather complicated data analysis software. CTIS developers will need to investigate needs for such analyses as the users become identified over the next few years. Currently, however, development of sophisticated mathematical data analysis software is probably not a pressing requirement.

INFORMATION ACCESS

Because of the Army emphasis on combined arms tactical training, developers from all service schools will probably require some information from sister institutions. Thus, the CTIS will need to be designed to facilitate rapid retrieval of data base contents in the developer's specialty area and in other areas which are closely related. This raises the question of which users will have access to various sections of the CTIS core data base, and whether portions of the data base will require restricted access. It seems likely, for example, that those developers concerned with intelligence, emerging systems, etc., may, for security reasons, require restricted access to parts of the data base. In addition, the CTIS core data base should be protected from unauthorized changes, and some software will be needed to insure that changes have the proper endorsements before the system will allow either deletions of existing information, or insertion of new information. One partial solution to the data base integrity issue would be to acquire a data base management system capable of creating "virtual file working structures," thus obviating requirements for temporary changes to core files during day-to-day operations. However, an authorization code system will need to be developed in any case, as changes to core files are inevitable.

A major CTIS development consideration involves the clearly sensitive nature of training data. Potential users at all levels expressed deep concern that training data might be misinterpreted or misused. One solution, of course, is to construct the system to safeguard the confidentiality of all training data by removing any unit identifiers from data transmitted to higher echelons, and by aggregating data into categories (e.g., functional areas) not traceable to specific units. One proposal consistent with current procedures in many units is to remove unit identifiers from data which is transmitted more than two echelons above the unit of origin. Thus, brigade headquarters would be able to identify specific companies and the division could identify units only down to

the battalion level. The central idea is to leave unit identifiers intact where they materially assist managers in setting training priorities and in allocating resources.

At the same time CTIS developers should be aware of significant moves in the Army toward greater training accountability. On the one hand, safeguarding data confidentiality drastically reduces the potential for misuse while, on the other hand, it virtually eliminates the use of such data for accountability purposes. For a number of technical reasons as well as the possibility of a shift in training accountability policy in future years, CTIS developers should insure that the relevant software is designed in modular formats to facilitate changes.

MANPOWER AND PERSONNEL

Respondents consistently reported personnel and manpower problems. In training development activities, new personnel must frequently be trained, leading to quality control and production problems. Also, operational units are rarely full strength, and turnover and turbulence tend to be severe. Therefore, the CTIS should be designed with a view toward minimizing the system personnel requirements, both in terms of numbers of people required for operations, and in terms of the data processing experience and expertise needed for effective use. The CTIS software design should incorporate as many "user friendly" functional routines as possible including menu operations, "help" commands, and so on. Also, user instructional courseware could be developed both to help users interact more effectively with the system, and to provide orientation to and basic instruction on the requirements of their jobs.

In addition, the feasibility of automating some functions which are currently executed manually should be examined. For example, much of the training development production work could be aided by the CTIS. Software to support formatting, printing camera-ready copy, final editing, preparation of production status reports, etc., could be developed for the CTIS. Since many commercial printers have changed from manual to computer-supported production systems, it is likely that some off-the-shelf software to support document production may be available. Likewise, the CTIS could be used to reduce units' manpower requirements by providing software and hardware to organize and print ARTEP exercise data collection forms, to reduce and analyze training data, and to prepare reports based on those data.

As noted earlier, the respondents complained consistently that they were often overburdened with paperwork. The CTIS developers could examine the feasibility of partially automating the field data collection process through the use of hand-held data collection devices. One approach is to load such devices with training objectives from a CTIS terminal interface, use the devices for field data collection, and then off-load the information from the devices back onto the CTIS terminal for analysis and report preparation. Such an extended CTIS terminal could significantly reduce units' manpower requirements for handling training data. This is a long-term effort and exploratory work would need to be undertaken in the near-term in order to realize the benefits 2-3 years from now.

High rates of turbulence indicate that feedback must be immediate to be of any use at squad, platoon, and company levels. At these echelons feedback should be very specific, sub-task oriented, and presented in a readily understandable format. In order to facilitate the incorporation of ARTEP feedback into immediate planning for corrective training, CTIS should be integrated with whatever system is developed to assist battalion training management.

DEVELOPMENT ISSUES

There are a variety of issues which should be addressed early in the CTIS development. These are, for the most part, beyond the scope of the user group surveys, but are nevertheless central to developing a workable CTIS design concept.

a. System Development. An integrated plan for CTIS development is central to insuring that the operational system will meet user needs, and that it is developed as cost-effectively as possible. Because of the broad scope of the effort the current information suggests that the system should be developed and implemented in phases. Initial efforts would focus on developing a system for training developers, while later phases would focus on a CTIS for operational units, senior executives, combat developers, doctrine developers and probably other users not yet identified.

A considerable amount of software will be needed to implement the CTIS. Most often, software developed for one computer system must be at least modified, and occasionally rewritten entirely, in order to run on other systems. It is likely this will be the case with the initial system developed for the Burroughs and a later one developed for the AMDAHL. Because such software developments are often time consuming and expensive, CTIS developers need to consider carefully the effects of producing software not readily transferable to the "end-product" system.

The initial tryout of the CTIS should, of course, be made with a limited prototype. Careful consideration will need to be made of what portions of the whole software package for each phase most require extensive user testing. In addition, it may be valuable to develop some limited programs to support the user tests. For example some simple programs which count the number of times each display is retrieved, the duration of that display is held on the screen, the sequences in which displays are retrieved, etc. could greatly assist in determining whether the system is being used as intended, and what kinds of changes would be advisable in the final version.

At some point, the CTIS will probably be integrated with the other ATIS subsystems. The nature of the interfaces and the requirements for transmitting data across the "subsystem boundaries" have not yet been determined. While the independence of the ATIS subsystems permits relatively rapid development of each one, this approach raises fundamental questions regarding compatibility among the subsystems. If developments for the ATIS subsystems proceed without unified technical management, the ultimate integration could prove extremely awkward and costly.

b. Configuration. It is expected that the system configuration will vary somewhat with the various users. The number of terminals required, graphics needs, maximum response times, and so on should be determined as early as possible. In addition, the location or locations of system data base(s) can be expected to have a major impact on requirements. For example, a centralized data base would allow the colocation of many peripherals, (e.g., the disc-drive systems which tend to be expensive). Distributed data bases, on the other hand, require distributed data processing equipment and would probably entail a substantial amount of hardware duplication. The trade-offs between system costs, response time requirements, access restrictions, etc., need to be thoroughly examined in order to produce a viable system concept.

CONCLUSIONS

There appears to be substantial support for the CTIS concept. The respondents, however, did express some reservations about the requirements for supporting such a system. CTIS developers will need to demonstrate to the users not only the benefits to be derived from implementing the system, but also that the costs (manpower, funds, etc.) born by the users are not excessive.

Respondents from operational units found the sample printouts to be potentially quite useful though they differed considerably in their ideas, what types of data would be most useful, how best to organize them, and what levels of aggregation would be most desirable. Training development respondents, on the other hand, did not find the examples particularly useful, mainly because they require information on fielded ARTEP materials rather than data on unit performance. Nevertheless, one might suggest that some performance-related data could be analyzed in ways which might help in the identification of problems with training objectives. This topic should be explored further.

Current plans call for the CTIS to be developed in three phases, each servicing the needs of one primary user group. Phase I will concentrate on ARTEP developers; Phase II, operational units; and Phase III, senior Army leaders, combat and doctrine developers, DA staff elements, etc. The plan for phased CTIS development was formulated after the survey was completed, and has not been a focus of the present report. The CTIS Phase I will, however, be the principal topic of the preliminary design concept report, currently scheduled to be completed later this year.

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